

WHAT IS CLAIMED IS:

1. A pressure relief device, comprising:

a sealing member having a domed shape including a concave and a convex side;

a non-symmetrical low-pressure support member configured to provide support along the concave side of the sealing member when the sealing member is subject to a certain pressure differential, the low pressure support member including an annular flange and at least one supporting projection;

a cutting element configured to puncture the sealing member when the sealing member is subject to a predetermined first pressure differential that causes collapse of the low pressure support member;

an inlet safety head member positioned on an inlet side of the low pressure support member;

an outlet safety head member positioned on an outlet side of the sealing member; and

wherein the inlet and outlet safety head members sealingly engage the low pressure support member and the sealing member therebetween.

2. The pressure relief device of claim 1, wherein the inlet and outlet safety head members form a pre-torqued assembly.

3. The pressure relief device of claim 1, wherein the at least one supporting projection of the low-pressure support member is an arch extending from a first interior point along the annular flange to a second interior point along the annular flange.

4. The pressure relief device of claim 1, further including a transition section in the low pressure support member extending inwardly from the annular flange and configured to provide support to the sealing member.

5. The pressure relief device of claim 1, including at least one support tongue formed along an interior portion of the annular flange of the low pressure support member and configured to provide support to the sealing member.

6. The pressure relief device of claim 3, wherein the annular flange includes an opening having a centerline and wherein the arch is entirely disposed on one side of the centerline.

7. The pressure relief device of claim 3, wherein the arch is configured to collapse when a predetermined force, caused by the predetermined first pressure differential, is exerted upon the sealing member such that the sealing member contacts the arch.

8. The pressure relief device of claim 3, wherein the arch includes at least one area of weakness.

9. The pressure relief device of claim 8, wherein the at least one area of weakness is formed wholly within the arch.

10. The pressure relief device of claim 8, wherein the at least one area of weakness is formed at a periphery of the arch.

11. The pressure relief device of claim 8, wherein the at least one area of weakness comprises a cut that extends across a segment of the arch and a connecting member connecting the arch across the cut.

12. The pressure relief device of claim 3, wherein the low-pressure support member includes multiple arches with at least two arches having different configurations.

13. The pressure relief device of claim 12, wherein one or more arches include at least one area of weakness.

14. The pressure relief device of claim 1, wherein the cutting element includes a blade and wherein the blade is configured not to contact the at least one supporting projection as the at least one supporting projection collapses.

15. The pressure relief device of claim 14, where the blade extends at an upward angle with respect to a plane including the annular flange.

16. The pressure relief device of claim 14, wherein the cutting element includes a second blade and a third blade, the second and third blades extending toward the interior of the annular flange.

17. A pressure relief device, comprising:

a sealing member having a domed shape including a concave and a convex side;

a non-symmetrical low-pressure support member configured to provide support along the concave side of the sealing member when the sealing member is subject to a certain pressure differential, the low pressure support member including an annular flange and at least one supporting projection;

a cutting element adapted to puncture the sealing member when the sealing member is subject to a predetermined first pressure differential;

a high-pressure support member configured to selectively provide support to the sealing member;

wherein the high-pressure support member is configured to rupture when the sealing member and high-pressure support member are subject to a predetermined second pressure differential; and

inlet and outlet safety head members positioned to sealingly engage the low pressure support member and the high pressure support member therebetween.

18. The pressure relief device of claim 17, wherein the inlet and outlet safety head members form a pre-torqued assembly.

19. The pressure relief device of claim 17, wherein the magnitude of the predetermined second pressure differential is greater than the magnitude of the predetermined first pressure differential.

20. The pressure relief device of claim 17, wherein the at least one supporting projection of the low-pressure support member is an arch extending from a first interior point along the annular flange to a second interior point along the annular flange.

21. The pressure relief device of claim 20, wherein the annular flange includes an opening having a centerline and wherein the arch is entirely disposed on one side of the centerline.

22. The pressure relief device of claim 20, wherein the arch is configured to collapse when a predetermined force, caused by the predetermined first pressure differential, is exerted upon the sealing member such that the sealing member contacts the arch.

23. The pressure relief device of claim 20, wherein the arch includes at least one area of weakness.

24. The pressure relief device of claim 23, wherein the at least one area of weakness is formed wholly within the arch.

25. The pressure relief device of claim 23, wherein the at least one area of weakness is formed at a periphery of the arch.

26. The pressure relief device of claim 20, wherein the low-pressure support member includes multiple arches with at least two arches having different configurations.

27. The pressure relief device of claim 17, wherein the cutting element includes a blade and wherein the blade is configured not to contact the at least one supporting projection as the at least one supporting projection collapses.

28. The pressure relief device of claim 27, wherein the cutting element includes multiple blades.

29. The pressure relief device of claim 17, wherein the high-pressure support member includes a main body having a substantially concave surface and a

substantially convex surface, the main body of high-pressure support member having at least one passageway therethrough and being configured to provide support to the convex side of the sealing member when the sealing member is subject to a certain pressure differential.

30. The pressure relief device of claim 29, further including at least one score or slit line formed in and dividing the main body into distinct sections.

31. The pressure relief device of claim 30, wherein the at least one score line includes a series of score or slit lines formed in the main body and dividing the main body into multiple petal sections.

32. The pressure relief device of claim 30, wherein the main body is configured to open along the at least one score or slit line dividing the main body of high-pressure support member when a predetermined force, caused by the predetermined second pressure differential, is exerted upon the sealing member such that the sealing member contacts the concave surface of the main body.

33. The pressure relief device of claim 26, wherein one or more arches include at least one area of weakness.

34. A pressure relief device, comprising:

a sealing member having a domed shape including a concave and a convex side;

a low-pressure support member configured to provide support along the concave side of the sealing member when the sealing member is subject to a certain pressure differential, the low pressure support member including an annular flange and at least one supporting projection having at least one area of weakness disposed therein; and

a cutting element configured to puncture the sealing member when the sealing member is subject to a predetermined first pressure differential that causes collapse of the low pressure support member.

35. The pressure relief device of claim 34, wherein the at least one supporting projection of the low-pressure support member is an arch extending from a first interior point along the annular flange to a second interior point along the annular flange.

36. The pressure relief device of claim 35, wherein the annular flange includes an opening having a centerline and wherein the arch is entirely disposed on one side of the centerline.

37. The pressure relief device of claim 35, wherein the arch is configured to collapse when a predetermined force, caused by the predetermined first pressure

differential, is exerted upon the sealing member such that the sealing member contacts the arch.

38. The pressure relief device of claim 35, wherein the at least one area of weakness is formed at a periphery of the arch.

39. The pressure relief device of claim 35, wherein the at least one area of weakness is formed wholly within the arch.

40. The pressure relief device of claim 35, wherein the low-pressure support member includes multiple arches with at least two arches having different configurations.

41. The pressure relief device of claim 40, wherein one or more arches include at least one area of weakness.

42. The pressure relief device of claim 34, further including inlet and outlet safety head members positioned to sealingly engage the low pressure support member and the sealing member therebetween as part of a pre-torqued assembly.

43. A pressure relief device, comprising:
a sealing member having a domed shape including a concave and a convex side;

a low-pressure support member configured to provide support along the concave side of the sealing member, the low pressure support member including an annular flange having an opening with a centerline, the low pressure support member further including at least one arch which extends from a first interior point along the annular flange to a second interior point along the annular flange;

wherein the first and second interior points are disposed on one side of the centerline and an apex of the at least one arch is disposed on an opposite side of the centerline; and

a cutting element configured to puncture the sealing member when the sealing member is subject to a predetermined first pressure differential that causes collapse of the low pressure support member.

44. The pressure relief device of claim 43, further including a high-pressure support member configured to selectively provide support to the sealing member; and

wherein the high-pressure support member is configured to rupture when the sealing member and high-pressure support member are subject to a predetermined second pressure differential.

45. The pressure relief device of claim 44, wherein the magnitude of the predetermined second pressure differential is greater than the magnitude of the predetermined first pressure differential.

46. The pressure relief device of claim 43, wherein the at least one arch is configured to collapse when a predetermined force, caused by the predetermined first pressure differential, is exerted upon the sealing member such that the sealing member contacts the at least one arch.

47. The pressure relief device of claim 43, wherein the at least one arch includes at least one area of weakness.

48. The pressure relief device of claim 47, wherein the at least one area of weakness is formed wholly within the at least one arch.

49. The pressure relief device of claim 47, wherein the at least one area of weakness is formed at a periphery of the at least one arch.

50. The pressure relief device of claim 43, wherein the low-pressure support member includes multiple arches with at least two arches having different configurations.

51. The pressure relief device of claim 44, wherein the high-pressure support member includes a main body having a substantially concave surface and a substantially convex surface, the main body of high-pressure support member having at least one passageway therethrough and being configured to provide

support to the convex side of the sealing member when the sealing member is subject to a certain pressure differential.

52. The pressure relief device of claim 50, wherein one or more arches include at least one area of weakness.

53. The pressure relief device of claim 43, further including inlet and outlet safety head members positioned to sealingly engage the low pressure support member and the sealing member therebetween as part of a pre-torqued assembly.

54. The pressure relief device of claim 44, further including inlet and outlet safety head members positioned to sealingly engage the low pressure support member and the high pressure support member therebetween as part of a pre-torqued assembly.

55. A pressure relief device, comprising:
a sealing member having a domed shape including a concave and a convex side;
a low-pressure support member configured to provide support along the concave side of the sealing member, the low pressure support member including an annular flange having an opening, the low pressure support member further including at least one symmetrical arch extending from one side of the opening to an opposite side of the opening;

a cutting element configured to puncture the sealing member when the sealing member is subject to a predetermined first pressure differential that causes collapse of the low pressure support member;

an inlet safety head member positioned on an inlet side of the low pressure support member;

an outlet safety head member positioned on an outlet side of the sealing member; and

wherein the inlet and outlet safety head members sealingly engage the low pressure support member and the sealing member therebetween.